Environmental Disasters and the Interface with One Health in Rio Grande do Sul: Challenges and Perspectives

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Using the One Health approach, this study aimed to examine the effects of climate disasters on the human-animal health interface in the context of Rio Grande do Sul. The research analyzed the impact of extreme weather events, such as floods and droughts, on public health, emphasizing the interdependence between humans, animals, and the environment. A systematic review assessed the literature on disasters within the One Health framework. As a result, interdisciplinary collaboration across various sectors has been emphasized as essential to addressing the challenges posed by environmental disasters. Such collaboration enables the formulation of more robust and practical strategies to mitigate the impacts of climate change.

Keywords: One Health. Climate Disasters. Animal-Human Health. Rio Grande do Sul.

Weather and climate significantly influence the water and energy systems and are essential to maintaining planetary balance and supporting human activity. However, extreme weather and climate events are major drivers of natural disasters.

Brazil is particularly vulnerable to climate change [1], and the state of Rio Grande do Sul (RS) has been severely impacted by floods since April 2024 [2]. These events, attributed to climate change, have led to environmental imbalances directly affecting human health. According to Martins Filho [2], a combination of a heatwave, a humidity corridor from the Amazon, and intense winds resulted in unprecedented precipitation, submerging large areas under water.

Natural disasters arise when extreme environmental events disrupt social systems, causing damage that surpasses local capacity to manage the crisis [3]. These events have profound implications for public health, animal health, and the environment—highlighting the relevance of the One Health approach. Initiatives such as "One World, One Health," led by the World Health Organization (WHO), the World Organisation for Animal Health (OIE), and the Food and Agriculture Organization (FAO), emphasize the interconnectedness of human, animal, and environmental health [4].

The Ministry of Health has adopted the One Health approach in Brazil, encouraging multidisciplinary cooperation to develop integrated solutions [5]. This approach recognizes the intrinsic link between environmental equilibrium and health outcomes [6]. The COVID-19 pandemic reinforced the urgency of addressing biodiversity and health in an integrated manner [7], underscoring the need to update national strategies to combat climate change, preserve biodiversity, and ensure food security and clean water access.

The recent environmental disaster in Rio Grande do Sul exemplifies the extreme weather events expected to become increasingly frequent. Therefore, developing new national disaster preparedness and management strategies is imperative. In recent years, the intensification of natural disasters in the region has been linked to global warming. Changes in sea surface temperature (SST) also play a significant role in climate variability [8], contributing to the severe flooding observed.

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Managing environmental risks such as floods remains a global challenge [9]. Solutions like dam construction—as illustrated by the Wivenhoe Dam in Australia—can be effective when accompanied by planned urban development [10]. However, inadequate land-use planning and improper waste disposal practices increase the risk of flooding and the spread of waterborne diseases. Land-use changes, such as deforestation and converting natural landscapes into urban areas, reduce vegetation cover and increase soil impermeability, worsening flood risks in areas with poor drainage infrastructure [11]. Therefore, effective land and waste management practices and structural measures like dams are essential. In addition, nature-based solutions—such as preserving riparian forests—are fundamental to flood mitigation [12].

Materials and Meethods

Method

This study employed a systematic review of the existing literature on climate disasters in the region and their impacts on health. The review followed the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines to ensure methodological rigor and transparency.

Data Collection

The literature search encompassed VHL, SciELO, Medline-PubMed, Google Scholar, Web of Science, and the Integrated Research Database of PUC-Rio. Search terms included "climate change AND Rio Grande do Sul" and "floods AND Southern Brazil." The review period spanned from 2019 to 2024. Exclusion criteria included duplicate records and articles that did not directly address the relationship between climate change and flooding in southern Brazil or lacked relevant empirical data.

After screening and selection, data from the remaining studies were organized into an Excel® spreadsheet and categorized by themes such as disasters, one health, and public policies. As illustrated in Figure 1, 27 articles were included in the final analysis.

Results and Discussion

This study's main findings and discussion are presented in two subsections, beginning with the results of the systematic literature review.

Results from the Article Search Method

The search strategy initially identified 1,487 publications. After applying the date filter (2019–2024), 450 articles remained. Following abstract screening, duplicates, studies conducted outside Brazil, and those considered irrelevant were excluded. Three researchers independently reviewed the remaining articles.

Following the final selection process, 3 peer-reviewed articles and 24 additional documents from the Integrated Research Database of PUC-Rio were included, resulting in a total of 27 articles analyzed. The predominant methodological approaches across the selected studies were qualitative, including case studies, document analysis, and interviews. Between 2018 and 2020, publications increased, followed by a decline in 2021–2022. As illustrated in Figure 2, a renewed increase occurred in 2023.

Figure 3 shows the main keywords identified in the articles. " Climate change" appears more frequently in the articles, corresponding to 25%, which corroborates the hypothesis that climate disasters have a direct link with climate change. Next, we have One health, master plan, public health, and Rio Grande do Sul, with a 7% incidence in the articles analyzed.

Environmental Disasters and One Health: Implications and Spread of Diseases in the Context of Rio Grande do Sul

Climate events are increasingly frequent, including floods, landslides, droughts, and

Figure 1. PRISMA 2020 flowchart.

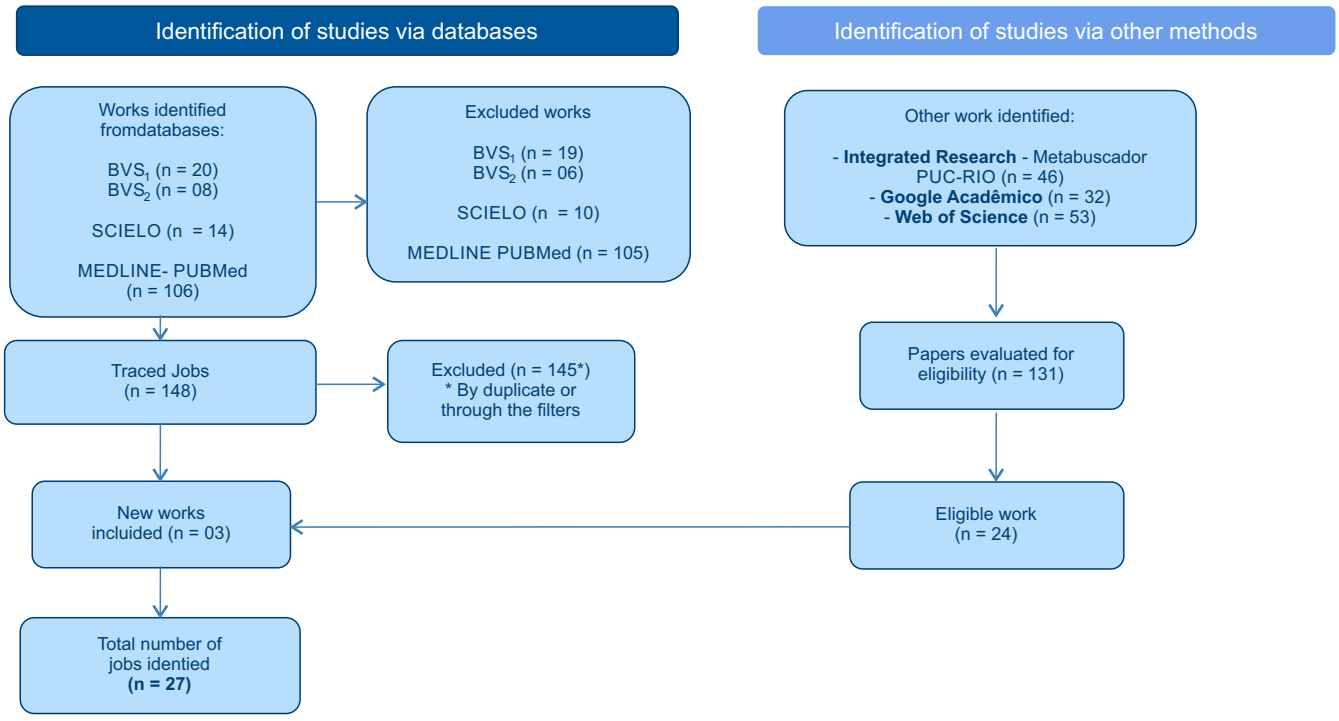


Figure 2. Number of articles per year of publication.

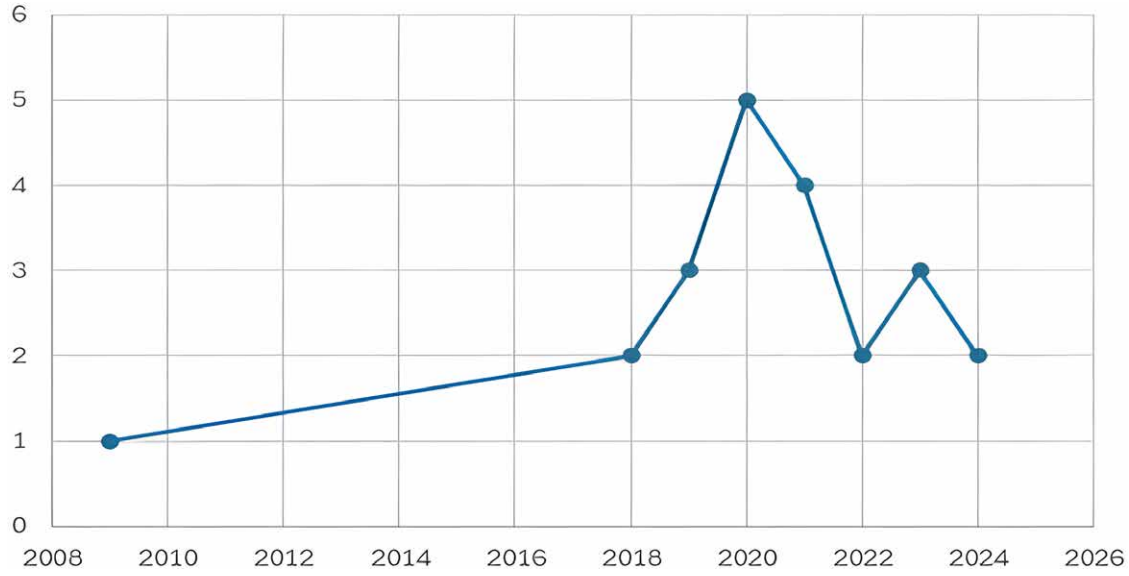
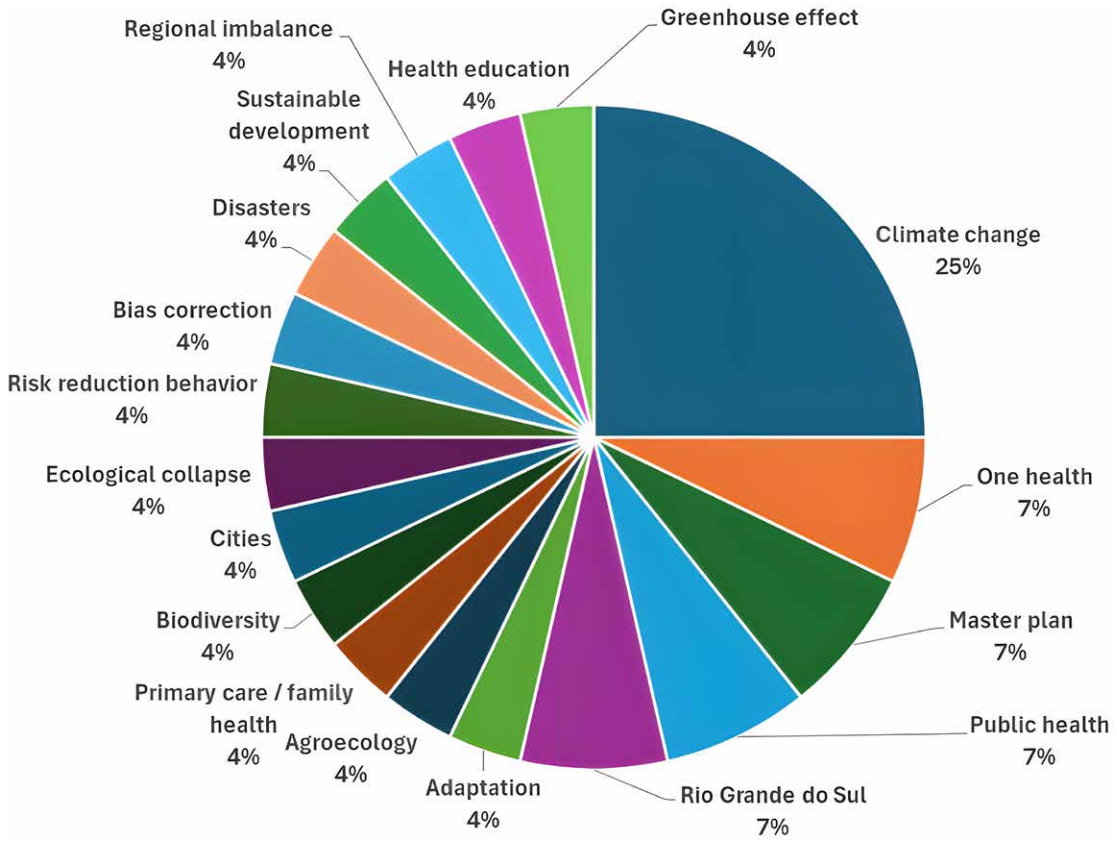


Figure 3. Most frequent keywords.



hurricanes, causing human and animal casualties, the spread of disease, and socioeconomic losses. These natural disasters are influenced by regional characteristics such as geology, soil, topography, and vegetation [13]. They may result from both internal dynamics of the Earth, such as earthquakes and volcanism, and external dynamics, such as storms and floods [14]. According to Castro (2023) [15], natural disasters can be classified into four levels of intensity, ranging from minor to severe, each with corresponding degrees of damage and loss.

Such events mobilize governments and society in search of rapid responses to minimize the loss of life and mitigate socioeconomic impacts—although some damages are irreversible. Rio Grande do Sul has experienced significant disasters, leading to human life and biodiversity losses. Floods and dam failures have disrupted biological cycles and essential environmental services, directly affecting community health and quality of life [16]. Consequences include polluted water bodies, the loss of flora and fauna, food insecurity, increased communicable diseases, and psychological and physical stress among affected populations [17]. Addressing these challenges requires an integrated approach rooted in the One Health paradigm, which links governmental decision-making and public policies to collaborative knowledge from diverse institutions [18]. Effective policies must consider local territorial characteristics, balancing identity preservation with operational efficiency [19].

The government of Rio Grande do Sul reported an increase in climate-related disasters between 2003 and 2021, with higher incidence rates from 2015 onward [8]. In 2023, Fiocruz's Climate and Health Observatory reported emergency and calamity decrees impacting 1,170 health facilities—including 548 clinics—resulting in a rise in medical emergencies and exacerbating chronic illnesses [20]. Between 2017 and 2021,

droughts, floods, and heavy rains affected 482 municipalities, impacting approximately 4.44 million people. In 2023, floods and flash floods affected 51 municipalities and 47,904 individuals. By 2024, new flooding events impacted 478 cities, affecting over 2.39 million people [21,20]. These extreme weather events elevate the risk of infectious disease outbreaks, necessitating swift public health responses [2]. Post-flood scenarios often see spikes in diarrheal illnesses and vector-borne infections, highlighting the urgent need for targeted health interventions [2].

A recent study reported nearly a 300% increase in hepatitis A cases following the Rio Grande do Sul floods, emphasizing the importance of preventive actions in post-disaster settings [22].

Climate change and environmental degradation contribute to a rise in emerging infectious diseases in humans and animals, with cross-species pathogen transmission posing a significant global health risk [23]. The analysis confirmed increased frequency and intensity of rainfall, extreme weather events, floods, droughts, tropical cyclones, and El Niño effects. The Intergovernmental Panel on Climate Change (IPCC) [24] has demonstrated how urbanization intensifies these phenomena by altering wind patterns, precipitation levels, and water runoff in urban areas.

Large-scale environmental disasters—such as the recent floods—underscore the urgent need to protect vulnerable populations, despite existing deficiencies in safety infrastructure. The Health Sector Disaster Preparedness and Response Guide [25] emphasizes that health outcomes depend heavily on the quality of emergency response, recovery, and reconstruction efforts. The interconnection between human and animal health during floods underlines the necessity of integrated public policies and coordinated governance. Embedding public health principles within disaster response strategies is imperative, especially in climate change. Interdisciplinary networks—such as those documented by Hoff (2023) [26] and Schramm (2024) [27]—have significantly influenced policy development. These networks, in partnership with governmental bodies, civil society, social movements, the armed forces, and academic institutions, have played a critical role in crafting policies to mitigate these crises' impacts.

Conclusion

With the progression of climate change, natural disasters are expected to become increasingly frequent, especially in large urban areas, where environmental, social, and economic repercussions will be more severe. Effective responses will require interdisciplinary cooperation and partnerships between national and international institutions to formulate and implement robust disaster preparedness and response strategies.

Integrating the human-animal-environment triad into public policy is essential. Actions such as comprehensive urban planning, efficient drainage systems, and strengthening infrastructure are critical for mitigating risks, increasing resilience, and ensuring that public health challenges are addressed in an integrated and sustainable manner.

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